REMARKS

The rejections, objections, and comments of the Examiner set forth in the Office Action dated April 2, 2002 have been carefully reviewed by the Applicants. Claims 1, 11, 23, and 26 (renumbered Claim 27) have been amended. The Applicants acknowledge that the numbering of Claims 27, 28, and 29 was not in accordance with 37 CFR 1.126 and that they have been renumbered 26, 27, and 28, respectively. Claims 1-28 are pending in the application. Claims 1-28 are currently rejected.

Claim 21 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 21 has been canceled.

Claims 1-4, 7-12, 14, 17-20, 23, 25, and 27 are rejected under 35 U.S.C 102(e) as being anticipated by Thei et al. (US 6,350,662 B1). Independent Claims 1, 11, 23, and 26 (renumbered Claim 27) , have been amended to patentably distinguish the present invention (as claimed in Claims 1-20 and 22-28) from Thei.

First, it should be noted that the process sequence of Thei as disclosed in the Abstract describes the forming of a thermal oxide, followed by a CVD oxide deposition, and a final step in which the entire substrate is annealed. Thei discloses the annealing of the combined thermal and CVD oxides in the Abstract and this teaching remains consistent throughout the disclosure.

The specific citation of the anneal process of Thei (col. 4 lines 1-10) by the Examiner is part of an overall process in which the anneal was preceded by a CVD oxide deposition (col. 3, lines 46-52). In contrast, as shown in Figure 5 of the present application, the liner oxide thermal growth and anneal have no intervening oxide deposition. This distinction is present in the Claims.

In the present invention, the liner oxide is annealed prior to the deposition of any further oxide. Claims 1, 11, 23, and 26 (renumbered Claim 27) have been amended to clearly indicate that the annealing step occurs prior to any further deposition of oxide. Since the amended Claims 1-20 and 22-28 reflect this process of liner oxide anneal prior to subsequent oxide deposition, the Applicants assert that Claims 1-20 and 22-28 are patentably distinct from Thei.

Claims 5, 15, and 28 (now Claim 27) are currently rejected under 35 U.S.C. 103(a) as being unpatentable over Thei et al. as applied to Claims 1-4, 7-12, 14, 17-20, 23, 25, and 27 above, and further in view of Wolf et al. As stated above, the Applicants have amended Claims 1-20 and 22-28 so that Thei, and the combination of Thei and Wolf, do not teach or suggest the claimed invention. The invention as claimed in Claims 5, 15, and 28 (now Claim 27) is neither taught nor suggested by combination of Thei and Wolf, since Wolf does not remedy the deficiencies of Thei.

Claims 6, 13, 22, 24, and 29 (now Claim 28) are currently rejected under 35 U.S.C. 103(a) as being unpatentable over Thei et al. as applied to Claims 1-4, 7-12, 14, 17-20, 23,

25, and 27 above, and further in view of Ishikawa et al. As stated above, the Applicants have amended Claims 1-20 and 22-28 so that Thei, and the combination of Thei and Ishikawa, do not teach or suggest the claimed invention. The invention as claimed in Claims 6, 13, 22, 24, and 29 (now Claim 28) is neither taught nor suggested by the combination of Thei and Ishikawa, since Ishikawa does not remedy the deficiencies of Thei.

The presence of a bulk oxide significantly alters the anneal process in two ways when compared to annealing of the liner oxide by itself. First, the stress state that influences the movement of atoms in the silicon lattice, and other species through the lattice, is quite different due to the bulk oxide, and in many cases the stress state will be dominated by the bulk oxide. Second, the bulk oxide provides a diffusion barrier that drastically impedes the exchange of species across the interface between the liner oxide and the gaseous process atmosphere.

The movement of atoms of the silicon lattice, and the movement of impurity atoms through the silicon lattice are inextricably linked to the stress fields produced by the oxide and silicon composite. An annealing process carried out with a bulk oxide in place, such as that of Thei, cannot be considered equivalent to an annealing process carried out in the absence of a bulk oxide, such as that of Claims 1-20 and 22-28.

In summary, the Applicants submit that amended Claims 1-20 and 22-28 are now in condition for allowance, and earnestly solicit such action from the Examiner.

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Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS

Claim 1 has been amended as follows:

1. A method of forming an isolation region in a semiconductor substrate comprising the steps of:

a) annealing a liner oxide in a trench in the surface of said semiconductor substrate, and

b) subsequently backfilling said trench with a bulk oxide

Claim 11 has been amended as follows:

11. A process for reducing leakage in forming an integrated circuit[,] structure comprising the steps of:

a) annealing a liner oxide layer in a shallow trench within a semiconductor substrate under conditions sufficient to reduce the rate of dislocations within said integrated circuit; and

b) subsequently chemical vapor depositing an oxide in said shallow trench.

Claim 23 has been amended as follows:

23. A process for forming the isolation regions in a semiconductor substrate comprising the steps of:

a) etching a trench in the surface of said semiconductor substrate, said trench having corners therein;

b) growing a liner oxide in said trench; and

c) annealing said liner oxide to reduce stresses at said corners; and

d) subsequently backfilling said trench with a bulk oxide.

Claim 26 has been amended as follows:

26. A process for growing and annealing liner oxide (LINOX) in a trench formed on the surface of a semiconductor comprising;

a) growing said liner oxide in said trench at a first temperature[,]; and

b) annealing said liner oxide prior to further oxide deposition at a second temperature higher than the first temperature elevated above that used in said step a) sufficient to reduce [relieve] stresses in said liner oxide.